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INITIAL PRODUCTION TEST OF THE AN/ARN-83 AUTOMATIC DIRECTION FI--ETC(U)
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USATECOM PROJECT NO. 4-6-3471-02

INITIAL PRODUCTION TEST

OF THE

AN/ARN-83 AUTOMATIC DIRECTION FINDING SET

RDT&E PROJECT NO. None

AD_____

Final Report of Test

Edward J. Dutton

24 March 1966

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

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DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

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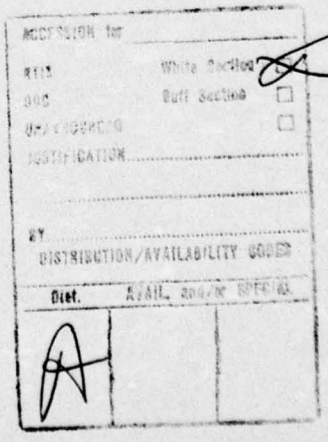

ABSTRACT

The USAAVNTBD conducted the Initial Production Test of the AN/ARN-83 Automatic Direction Finding Set in the vicinity of Fort Rucker, Alabama, from 3 January to 23 February 1966. The ADF's were installed in a UH-1D Helicopter and a U-8D Airplane and were operated in flight for 54 hours during the tests. The general concept of this test was to verify adequacy and quality of the AN/ARN-83 by performing the same operational and flight tests on the AN/ARN-83 as those conducted on the off-the-shelf ADF. Additional tests were conducted to determine whether the deficiencies and shortcomings of the off-the-shelf equipment had been corrected. The installation characteristics were adequate and were the same as those of the previously-tested off-the-shelf equipment. The in-flight performance of the AN/ARN-83 was adequate and comparable to that of the previously-tested off-the-shelf equipment. Maintenance and support requirements reported for the off-the-shelf equipment remained unchanged. Three of the four deficiencies previously reported were corrected. Linear index markings on the frequency dial were not provided as previously recommended. The previously-reported shortcomings were not corrected, and one additional shortcoming was noted. It was concluded that the adequacy and the quality of the production AN/ARN-83 have been improved by the correction of the three previously-reported deficiencies, that the AN/ARN-83 will be suitable for Army use when the deficiency is corrected, and that correction of the shortcomings would enhance the suitability of the AN/ARN-83. It was recommended that the deficiency be corrected and that the shortcomings be corrected if technically and economically feasible.

FOREWORD

The Commanding General, US Army Test and Evaluation Command, directed the initial production test of the AN/ARN-83 Direction Finding Set in letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 28 September 1965, subject: "Test Directive, Initial Production Test, Direction Finding Set, AN/ARN-83, USATECOM Project No. 4-6-3471-01/02."

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

"INITIAL PRODUCTION TEST

OF THE

AN/ARN-83 AUTOMATIC DIRECTION FINDING SET"

USATECOM PROJECT NO. 4-6-3471-02

Table of Contents

	Page No.
SECTION 1 - GENERAL	1
1.1. Objectives	3
1.2. Responsibilities	3
1.3. Description of Materiel	3
1.4. Background	4
1.5. Findings	4
1.6. Conclusions	5
1.7. Recommendations	5
SECTION 2 - DETAILS AND RESULTS OF SUBTESTS	7
2.0. Introduction	9
2.1. Installation Characteristics	9
2.2. In-Flight Performance	10
2.3. Maintenance and Support	13
2.4. Deficiencies	15

SELECTED BIBLIOGRAPHY

1. Letter, AMSEL-AV-E, Headquarters, US Army Electronics Command, 24 February 1964, subject: "Modernization Program for OMNI-Range Receivers, Automatic Direction Finding Equipment and Lightweight HF Aircraft Radio Sets," with one inclosure.

2. Letter, AMSEL-PP-ESD-4, Headquarters, US Army Electronics Command, 26 July 1964, subject: "Request for Test of Direction Finder Set AN/ARN-83."

3. Signal Corps Letter (SCL) 8012B, "Direction Finder, Automatic Lightweight, Airborne," US Army Electronics Command, 10 July 1964, with Amendment No. 1, dated 7 August 1964.

4. Plan of Test, USATECOM Project No. 4-6-3471-02, "Plan of Test for AN/ARN-83, Direction Finding Set," US Army Aviation Test Board, 8 November 1965.

5. Message, AMCPM-IR-P AMC20627, Commanding General, US Army Materiel Command, 3 February 1966, subject: "Compatibility Testing of AN/ARN-82 and AN/ARN-83 Radio Sets in UH-1 Helicopters, USATECOM Project 4-6-3461 & 4-6-3471."

SECTION 1 - GENERAL

1.1. OBJECTIVES.

1.1.1. Purpose.

To verify the adequacy and quality of the production AN/ARN-83 Automatic Direction Finder Set.

1.1.2. Test Objectives.

a. To verify installation characteristics.

b. To verify in-flight performance.

c. To determine maintenance and support requirements.

d. To determine the adequacy of corrective action on previously-reported deficiencies. [1]

1.2. RESPONSIBILITIES.

1.2.1. The US Army Aviation Test Board (USAAVNTBD) was responsible for preparing the test plan, conducting the test, and reporting of operational and flight tests of the AN/ARN-83 (USATECOM Project No. 4-6-3471-02).

1.2.2. The US Army Electronic Proving Ground (USAEPG) was responsible for the engineering-type test (USATECOM Project No. 4-6-3471-01).

1.3. DESCRIPTION OF MATERIEL.

The AN/ARN-83 is a lightweight airborne navigation set that automatically provides a visual indication of aircraft bearing with respect to a low- or medium-frequency radio transmitter. The frequency coverage is 190 kilocycles (kc.) to 1,750 kc. on three bands. The system, less cables, weighs 18.25 pounds and consists of six major components: control unit, receiver, bearing indicator, loop antenna, sense antenna coupler, and mountings. The set does not include a sense antenna.

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[1] Report of Test, "Military Potential Test (Comparative Evaluation) of Automatic Direction Finding Equipment," DA Project No. 1G641203D526, USATECOM Project No. 4-4-4316-01, US Army Aviation Test Board, 4 February 1965.

1.4. BACKGROUND.

1.4.1. In the interest of obtaining the most modern equipment for the Army, the Assistant Secretary of the Army (Installation and Logistics) directed in November 1963 that available off-the-shelf automatic direction finding (ADF) equipment be comparatively evaluated to select candidates for replacement of the AN/ARN-59.[2] The US Army Electronics Command (USAECOM) selected three different ADF designs which later were evaluated by the USAAVNTBD, USAEPG, and the US Army Human Engineering Laboratory (USAHEL). Formal tests started 1 October 1964 and were concluded 15 December 1964.

1.4.2. The off-the-shelf equivalent to the AN/ARN-83 was selected as the most suitable for Army use. The USAAVNTBD report of test[3] concluded that the deficiencies found during the test must be corrected prior to type classification and recommended that the system undergo a complete engineering and service test prior to acceptance as a standard item.

1.4.3. The AN/ARN-83 was type classified Standard A in September 1965. The US Army Test and Evaluation Command (USATECOM) has recommended that engineering and service tests be conducted on the AN/ARN-83, but approval has not yet been received.

1.5. FINDINGS.

1.5.1. The installation characteristics were adequate and were the same as those of the previously-tested off-the-shelf equipment.

1.5.2. The in-flight performance of the AN/ARN-83 was adequate and comparable to that of the previously-tested off-the-shelf equipment.

1.5.3. The nature of the production modifications was such that the maintenance and support requirements reported for the off-the-shelf equipment remained unchanged.

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[2]Letter, Assistant Secretary of the Army (ASA), Installation and Logistics (Mr. Ignatius), 13 November 1963, subject: "FY 64 Procurement of Avionics Equipment," with five indorsements.

[3]Report of Test, "Military Potential Test (Comparative Evaluation) of Automatic Direction Finding Equipment," DA Project No. 1G641203D526, USATECOM Project No. 4-4-4316-01, US Army Aviation Test Board, 4 February 1965.

1.5.4. Three of the four deficiencies previously reported were corrected. Linear index markings on the frequency dial were not provided as previously recommended. The previously-reported shortcomings were not corrected, and one additional shortcoming was noted.

1.6. CONCLUSIONS.

1.6.1. The adequacy and the quality of the production AN/ARN-83 have been improved by the correction of three previously-reported deficiencies.

1.6.2. The AN/ARN-83 will be suitable for Army use when the deficiency listed in paragraph 2.4.3, section 2, is corrected.

1.6.3. Correction of the shortcomings listed in paragraph 2.4.3, section 2, would enhance the suitability of the AN/ARN-83.

1.7. RECOMMENDATIONS.

It is recommended that:

1.7.1. The deficiency listed in paragraph 2.4.3, section 2, be corrected.

1.7.2. The shortcomings listed in paragraph 2.4.3, section 2, be corrected if technically and economically feasible.

SECTION 2 - DETAILS AND RESULTS OF SUBTESTS

2.0. INTRODUCTION.

The AN/ARN-83 ADF was evaluated in the vicinity of Fort Rucker, Alabama, from 3 January 1966 to 23 February 1966. The ADF's were installed in a UH-1D Helicopter and a U-8D Airplane and were operated in flight for 54 hours during the tests. The general concept of this test was to verify adequacy and quality of the AN/ARN-83 by performing the same operational and flight tests on the AN/ARN-83 as those conducted on the off-the-shelf ADF. Additional tests were conducted to determine whether the deficiencies and shortcomings of the off-the-shelf equipment had been corrected.

2.1. INSTALLATION CHARACTERISTICS.

2.1.1. Objective.

To verify that the installation characteristics of the AN/ARN-83 ADF are equal to or better than those of the off-the-shelf equipment previously tested.

2.1.2. Method.

2.1.2.1. The AN/ARN-83 was weighed and measured. The weight and dimensions were compared with those of the off-the-shelf equipment to determine any differences.

2.1.2.2. The AN/ARN-83 ADF was installed in the test-bed aircraft to verify the adequacy of installation instructions, drawings, and diagrams.

2.1.2.3. The AN/ARN-83 ADF was inspected and installed in the test-bed aircraft. Any variation in type, size, or mounting requirements, including size of skin cuts, from that of the off-the-shelf equipment was noted.

2.1.3. Results.

2.1.3.1. The total weight and dimensions were the same as the off-the-shelf equipment.

2.1.3.2. The installation instructions, drawings, and diagrams were not in the prescribed Army technical-manual format; however, they were adequate for test purposes.

2.1.3.3. No variations were noted between the type, size, and mounting requirements of the AN/ARN-83 antenna and the off-the-shelf antenna previously tested.

2.1.4. Analysis.

The installation characteristics of the AN/ARN-83 were adequate and were the same as those of the off-the-shelf equipment previously tested.

2.2. IN-FLIGHT PERFORMANCE.

2.2.1. Objective.

To verify that the in-flight performance of the AN/ARN-83 ADF is adequate and comparable to that of the previously-tested off-the-shelf equipment.

2.2.2. Method.

2.2.2.1. Maximum Range.

Each aircraft with the AN/ARN-83 ADF installed was flown along selected ground tracks, separated by at least 60 degrees, to and from low frequency (LF) and medium frequency (MF) ground stations until excessive oscillation of the bearing indicator (plus or minus 5 degrees) or until loss of aural signal indicated maximum usable range. These flights were conducted at 1,500 feet mean sea level (m.s.l.) (approximately 1,250 feet absolute altitude).

2.2.2.2. Track Following in ADF Mode.

With the AN/ARN-83 in ADF mode, each aircraft was flown over four or more selected ground tracks to and from LF ground stations and the following were observed:

a. Difficulties in tracking attributable to the equipment.

b. Adequacy of station passage indication.

c. "Hunting" of the bearing indicator needle.

d. Other unusual equipment performance.

2.2.2.3. Track Following in LOOP Mode.

The test in paragraph 2.2.2.1 was repeated using track following in the LOOP mode of the AN/ARN-83. The following were observed:

a. Effect of volume control adjustment upon null width.

b. Narrowing and then definite widening of the null in station passage.

c. Overall operation of the AN/ARN-83 in the LOOP mode.

2.2.2.4. Orientation and Time-Distance Calculations.

Each aircraft was flown at 1,500 feet m.s.l. to verify the adequacy of the AN/ARN-83 ADF in the areas of:

a. ADF orientation.

b. Loop orientation.

c. Station identification.

d. Information for performance of time-distance calculations.

e. Voice reception (clarity, tone).

2.2.2.5. ADF and Manual Loop Approaches.

Radio compass approaches using the manual and automatic modes of operation of the AN/ARN-83 ADF were executed and the capability of the ADF to position the aircraft along a selected ground track for low approaches without excessive needle oscillation or erroneous reversal was evaluated.

2.2.2.6. Effects of Meteorological Conditions.

Each aircraft was flown during the hours of daylight and darkness and in all available weather conditions. The effects of meteorological conditions on the performance of the AN/ARN-83 ADF were noted.

2.2.2.7. Electronic Interference.

The AN/ARN-83 ADF was operated in conjunction with various combinations of other electronic equipment installed in the aircraft to determine the existence of any mutual interference.

2.2.2.8. Helicopter Sling Loads.

The requirement to determine the effects of external sling loads on the AN/ARN-83 was cancelled.[4]

2.2.3. Results.

2.2.3.1. Maximum Range.

At 1,500 feet m.s.l., over flat terrain, the AN/ARN-83 had an average maximum range of 80 nautical miles.

2.2.3.2. Track Following in ADF Mode.

The AN/ARN-83 functioned satisfactorily during track following in the ADF mode of operation. Station passage indications were adequate, and neither "hunting" of the bearing indicator needle nor any unusual equipment performance was noted.

2.2.3.3. Track Following in LOOP Mode.

2.2.3.3.1. In the LOOP mode of operation, normal null-width changes occurred during station passage and during changes in the volume control setting.

2.2.3.3.2. Commercial broadcast stations (which are in the high band of the receiver) were difficult to separate, causing the bearing indicator needle to "hunt."

2.2.3.4. Orientation and Time-Distance Calculations.

The AN/ARN-83 functioned satisfactorily during ADF orientation, loop orientation, station identification, and performance of time

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[4]Message, AMSEL-PP-EA-880, Commanding General, US Army Electronics Command, subject: "Initial Production Test AN/ARN-82 and AN/ARN-83."

distance calculations. The voice reception was equal to the off-the-shelf equipment previously tested.

2.2.3.5. ADF and Manual Loop Approaches.

The AN/ARN-83 functioned satisfactorily during ADF and manual loop approaches.

2.2.3.6. Effects of Meteorological Conditions.

2.2.3.6.1. Day and night operation using the ADF was satisfactory.

2.2.3.6.2. Weather during the test flights did not include IFR conditions. Therefore, the effects of severe meteorological conditions were not determined.

2.2.3.7. Electronic Interference.

No mutual interference was noted when the AN/ARN-83 was operated with other installed avionic equipment.

2.2.4. Analysis.

The in-flight performance of the AN/ARN-83 was adequate and comparable to that of the previously-tested off-the-shelf equipment.

2.3. MAINTENANCE AND SUPPORT.

2.3.1. Objective.

To determine maintenance and support requirements.

2.3.2. Method.

2.3.2.1. Maintenance History.

For each AN/ARN-83 ADF installation, the following were recorded:

a. Total operating time.

b. Total number of failures.

c. Hours of operation at time of failure.

d. Cause of failure.

e. Time required for repair.

f. Parts required for repair.

2.3.2.2. Ease of Maintenance.

The AN/ARN-83 ADF was examined and the following ease-of-maintenance features were noted:

a. Packaging.

b. Density of components.

c. Ease of component exchange.

d. Ease of failure isolation.

e. Availability and accessibility of test points.

2.3.2.3. Support Requirements.

2.3.2.3.1. The AN/ARN-83 ADF was maintained using the standard avionic maintenance tool kits and test equipment. Any additional tools or special test equipment required were noted.

2.3.2.3.2. The components of the AN/ARN-83 ADF were examined for nonstandard parts, high-cost items, critical replacement parts, and other parts not normally available in Army supply channels.

2.3.2.4. Training Requirements.

During the conduct of all maintenance operations, skill levels and training of personnel required to maintain the AN/ARN-83 were noted.

2.3.2.5. Routine Maintenance.

The time and number of personnel required to identify malfunctions were recorded. The time interval between inspections and between equipment alignment was compared to that of existing procedures.

2.3.3. Results.

The AN/ARN-83 was operated a total of 54 hours without failures. No parts were replaced. The nature of the modifications was such that the maintenance and support requirements reported for the off-the-shelf set remained unchanged.

2.3.4. Analysis.

Not applicable.

2.4. DEFICIENCIES.

2.4.1. Objective.

To determine the adequacy of corrective action on previously-reported deficiencies.

2.4.2. Method.

2.4.2.1. The frequency dial index on the control unit was inspected for linear markings in kilocycles.

2.4.2.2. The BFO switch was operated by the pilot while wearing winter gloves.

2.4.2.3. The AN/ARN-83 ADF was operated during periods of darkness.

2.4.3. Results.

2.4.3.1. Deficiencies.

No deficiencies were discovered during this test. The status of the previously-reported deficiencies is as follows:

Previously-Reported Deficiency	Suggested Corrective Action	Findings This Test
a. On the ADF control unit, the frequency dial index markings were non-linear.	Replace with linear markings in kilocycles.	Deficiency still exists.

Previously-Reported Deficiency	Suggested Corrective Action	Findings This Test
b. The frequency dial index was marked in megacycles rather than in kilocycles.	Replace with linear markings in kilocycles.	Deficiency has been satisfactorily corrected.
c. The knob markings were not illuminated.	Illuminate knob markings.	Deficiency has been satisfactorily corrected.
d. The BFO switch was too small.	Replace with larger switch.	Deficiency has been corrected; however, see paragraph 2.4.3.2.2. below.

2.4.3.2. Shortcomings.

2.4.3.2.1. The status of previously-reported shortcomings is as follows:

Previously-Reported Shortcoming	Suggested Corrective Action	Findings This Test
a. No fail-safe device was provided on the system (SCL 8012B).	None.	Shortcoming still exists.
b. System did not meet SCL or TSO requirement on Receiver Selectivity.	None.	To be reported as a result of engineering tests.
c. System did not meet SCL or TSO requirement on loop sensitivity.	None.	To be reported as a result of engineering tests.

Previously-Reported Shortcoming	Suggested Corrective Action	Findings This Test
d. Volume was two percent greater than the 750-cubic inch-limit.	None.	Shortcoming still exists. The size of the set was not changed.
e. Power consumption was five percent greater than the limit.	None.	To be reported as a result of engineering tests.
f. System did not meet SCL or TSO requirement on Image Rejection.	None.	To be reported as a result of engineering tests.

2.4.3.2.2. Two shortcomings were discovered during this test:

Shortcoming	Suggested Corrective Action	Remarks
a. The new BFO switch is too long and can be easily damaged by maintenance and operator personnel.	None.	This shortcoming is a result of a modification to correct a deficiency (paragraph 2.4.3.1.d).
b. The manufacturer's publications provided were not in the Army format.	Provide manuals in the proper Army format.	

2.4.4. Analysis.

Not applicable.